working electrode and the reference electrode is passed through the at least partially surrounding portion. The method can include wirelessly indicating the measured amperometric current via an antenna embedded within the eye-mountable device.

[0007] These as well as other aspects, advantages, and alternatives, will become apparent to those of ordinary skill in the art by reading the following detailed description, with reference where appropriate to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a block diagram of an example system that includes an eye-mountable device in wireless communication with an external reader.

[0009] FIG. **2**A is a bottom view of an example eye-mountable device.

[0010] FIG. **2**B is an aspect view of the example eye-mountable device shown in FIG. **2**A.

[0011] FIG. **2**C is a side cross-section view of the example eye-mountable device shown in FIGS. **2**A and **2**B while mounted to a corneal surface of an eye.

[0012] FIG. **2**D is a side cross-section view enhanced to show the tear film layers surrounding the surfaces of the example eye-mountable device when mounted as shown in FIG. **2**C.

[0013] FIG. **3** is a functional block diagram of an example system for electrochemically measuring a tear film analyte concentration.

[0014] FIG. **4**A is a flowchart of an example process for operating an electrochemical sensor in an eye-mountable device to measure a tear film analyte concentration.

[0015] FIG. **4**B is a flowchart of an example process for operating an external reader to interrogate an electrochemical sensor in an eye-mountable device to measure a tear film analyte concentration.

[0016] FIG. **5**A shows an example configuration in which an electrochemical sensor detects an analyte that diffuses from a tear film through a polymeric material.

[0017] FIG. **5**B shows an example configuration in which an electrochemical sensor detects an analyte in a tear film that contacts the sensor via a channel in a polymeric material.

[0018] FIG. **5**C shows an example configuration in which an electrochemical sensor detects an analyte that diffuses from a tear film through a thinned region of a polymeric material.

[0019] FIG. **5**D shows another example configuration in which an electrochemical sensor detects an analyte that diffuses from a tear film layer through a polymeric material.

[0020] FIG. **5**E shows another example configuration in which an electrochemical sensor detects an analyte a tear film layer that contacts the sensor via a channel in a polymeric material.

[0021] FIG. **5**F shows another example configuration in which an electrochemical sensor detects an analyte that diffuses from a tear film layer through a thinned region of a polymeric material.

[0022] FIG. **6**A illustrates one example arrangement for electrodes in an electrochemical sensor.

[0023] FIG. **6**B illustrates another example arrangement for electrodes in an electrochemical sensor.

[0024] FIG. **7**A illustrates an example coplanar arrangement for electrodes in an electrochemical sensor.

[0025] FIG. **7**B illustrates an example non-coplanar arrangement for electrodes in an electrochemical sensor.

DETAILED DESCRIPTION

[0026] In the following detailed description, reference is made to the accompanying figures, which form a part hereof. In the figures, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, figures, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the scope of the subject matter presented herein. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, separated, and designed in a wide variety of different configurations, all of which are explicitly contemplated herein.

I. Overview

[0027] An ophthalmic sensing platform can include a sensor, control electronics and an antenna all situated on a substrate embedded in a polymeric material formed to be contact mounted to an eye. The control electronics can operate the sensor to perform readings and can operate the antenna to wirelessly communicate the readings from the sensor to an external reader via the antenna.

[0028] The polymeric material can be in the form of a round lens with a concave curvature configured to mount to a corneal surface of an eye. The substrate can be embedded near the periphery of the polymeric material to avoid interference with incident light received closer to the central region of the cornea. The sensor can be arranged on the substrate to face inward, toward the corneal surface so as to generate clinically relevant readings from near the surface of the cornea and/or from tear fluid interposed between the contact lens and the corneal surface. In some examples, the sensor is entirely embedded within the contact lens material. For example, the sensor can be suspended in the lens material and situated such that the working electrode is less than 10 micrometers from the polymeric surface configured to mount to the cornea. The sensor can generate an output signal indicative of a concentration of an analyte that diffuses through the lens material to the embedded sensor.

[0029] The ophthalmic sensing platform can be powered via radiated energy harvested at the sensing platform. Power can be provided by light energizing photovoltaic cells included on the sensing platform. Additionally or alternatively, power can be provided by radio frequency energy harvested from the antenna. A rectifier and/or regulator can be incorporated with the control electronics to generate a stable DC voltage to power the sensing platform from the harvested energy. The antenna can be arranged as a loop of conductive material with leads connected to the control electronics. In some embodiments, such a loop antenna can wirelessly also communicate the sensor readings to an external reader by modifying the impedance of the loop antenna so as to modify backscatter radiation from the antenna.

[0030] Human tear fluid contains a variety of inorganic electrolytes (e.g., Ca^{2+}, Mg^{2+}, Cl^-), organic solutes (e.g., glucose, lactate, etc.), proteins, and lipids. A contact lens with one or more sensors that can measure one or more of these components provides a convenient non-invasive platform to diagnose or monitor health related problems. An example is a glucose sensing contact lens that can potentially be used for diabetic patients to monitor and control their blood glucose level.